Remarks: Claim Amendments

Amendments to the claims were made to better clarify the novel features of the invention over the prior art and to amend deficiencies not by the Examiner. In particular, the following changes were made:

In the amended Claim 1, the phrase

"— receiving a plurality of transmitted signals with a plurality of receiver elements —"

was replaced by

"— receiving a plurality of transmission signals with a plurality of receiver elements wherein said plurality of transmission signals are transmitted by a transmitter having a plurality of transmitting elements —".

A transmitter having a plurality of transmitting elements is recited in Claim 3 of the original filed Parent application (Ser. No. 08/862,859, filed May 23, 1997) of which the present application is a Division.

Claims 2 through 6 are unchanged.

In the amended Claim 7, the phrase "— the receiver elements are polarization elements —" was changed to "—the receiver elements include more than two polarization elements —". This change was made to better distinguish the claimed invention over the prior art.

The invention discloses cross-polarization interference cancellation for more than two polarization states. For example, on page 19, line 29 to page 20, line 1 of the specification: "the spatial demultiplexer 403 may be used as a polarization demultiplexer to separate a plurality of received polarization signals $p_n(t)$ (n=1,...,N), each having a known linear polarization φ_n." Page 20, lines 12-14 of the specification states, "the

advantage of this method is that it provides for polarization demultiplexing of more than two linearly polarized signals $s_n(t)$."

In the amended Claim 8, the term "— optimization step —" was replaced with "— optimization process —" in order to provide correct antecedent basis, as required by the Examiner.

In the amended Claim 9, "— claim 9 —" was replaced with "— claim 8 —" so that Claim 9 no longer depends on itself, as required by the Examiner.

Claims 10 through 18 are unchanged.

In the amended Claim 19, the phrase

"— transmitting a plurality of transmission signals having at least one common frequency channel —"

was replaced by

"— transmitting a plurality of transmission signals from a transmitter having a plurality of transmitting elements wherein the plurality of transmission signals have at least one common frequency channel —".

A transmitter having a plurality of transmitting elements is recited in Claim 3 of the original filed Parent application (Ser. No. 08/862,859, filed May 23, 1997) of which the present application is a Division.

In the amended Claim 20, the phrase

"— from a transmitter having a plurality of transmitter elements —"

was added to the preamble

Also, a typographical error was corrected.

A transmitter having a plurality of transmitting elements is recited in Claim 3 of the original filed Parent application (Ser. No. 08/862,859, filed May 23, 1997) of which the present application is a Division.

In the amended Claim 21, the phrase

"— providing transmission of a plurality of transmission signals having at least one common frequency channel — "

was replaced by

"— providing transmission by a transmitter having a plurality of transmitter elements of a plurality of transmission signals having at least one common frequency channel —".

A transmitter having a plurality of transmitting elements is recited in Claim 3 of the original filed Parent application (Ser. No. 08/862,859 filed May 23, 1997) of which the present application is a Division.

In the amended Claim 21, a typographical error was corrected.

In the amended Claim 22, the phrase "— adjusting the at least one transmission parameter —" was changed to "— adjusting at least one transmission parameter —" in order to provide correct antecedent basis, as required by the Examiner.

The phrase "— receiving a plurality of transmission signals transmitted in at least one common frequency channel for providing a plurality of received signals —" was changed to "— receiving a plurality of transmission signals transmitted in at least one common frequency channel by said plurality of receiver elements for providing a plurality of received signals —".

In the amended Claim 23, the phrase "— A method of separating received transmission signals having known ratios of co-channel interference— " was changed to "— A method

of separating a plurality of received transmission signals transmitted by at least one transmitter having a plurality of transmitter elements, the received transmission signals having known ratios of co-channel interference —".

A transmitter having a plurality of transmitting elements is recited in Claim 3 of the original filed Parent application (Ser. No. 08/862,859 filed May 23, 1997) of which the present application is a Division.

Claim 24 was withdrawn.

In the amended Claim 25, the phrase:

"— a signal canceller capable of separating one or more transmission signals from a plurality of interfering transmission signals received by a receiver —"

was replaced with:

"— a signal canceller capable of separating one or more transmission signals from a plurality of interfering transmission signals transmitted by at least one transmitter having a plurality of transmitter elements and received by a receiver having a plurality of receiver elements, the signal canceller adapted to be coupled to the receiver —".

A transmitter having a plurality of transmitting elements is recited in Claim 3 of the original filed Parent application (Ser. No. 08/862,859 filed May 23, 1997) of which the present application is a Division.

In the amended Claim 26, the phrase:

"— a signal canceller capable of separating one or more transmission signals from a plurality of interfering transmission received by a receiver —"

was replaced with:

"— a signal canceller capable of separating one or more transmission signals from a plurality of interfering transmission signals transmitted by at least one transmitter having a plurality of transmitter elements and received by a receiver having a plurality of receiver elements —".

A transmitter having a plurality of transmitting elements is recited in Claim 3 of the original filed Parent application (Ser. No. 08/862,859 filed May 23, 1997) of which the present application is a Division.

In the amended Claim 27, the phrase:

"— a receiver capable of separating a plurality of received transmission signals —"

was replaced with:

"— a receiver capable of separating a plurality of received transmission signals transmitted by at least one transmitter having a plurality of transmitter elements —".

A transmitter having a plurality of transmitting elements is recited in Claim 3 of the original filed Parent application (Ser. No. 08/862,859 filed May 23, 1997) of which the present application is a Division.

Claim 28 is unchanged.

In Claim 29, the phrase:

"a receiver capable of receiving a plurality of algebraically unique proportions of a plurality of differently polarized transmission signals"

was replaced with:

"a receiver capable of receiving a plurality of algebraically unique proportions of more than two differently polarized transmission signals".

The invention discloses cross-polarization interference cancellation for more than two polarization states. For example, on page 19, line 29 to page 20, line 1 of the specification: "the spatial demultiplexer 403 may be used as a polarization demultiplexer to separate a plurality of received polarization signals $p_n(t)$ (n=1,...,N), each having a known linear polarization φ_n." Page 20, lines 12-14 of the specification states, "the

advantage of this method is that it provides for polarization demultiplexing of more than two linearly polarized signals $s_n(t)$."

Remarks: Examination Report

It is submitted that with the amended claims herein, the objections raised against the claims are overcome.

1. Section 1 of the Examination Report

It is noted that Claim 24 was withdrawn from further consideration.

2. Section 2 of the Examination Report

The rejection of Claims 8-13 and 22 under 35 U.S.C. 112 is noted.

3. Section 3 of the Examination Report

Amendments were made to Claims 8-13 and 22 in order to overcome this rejection:

In the amended Claim 8, the term "— optimization step —" was replaced with "— optimization process —" in order to provide correct antecedent basis.

In the amended Claim 9, "— claim 9 —" was replaced with "— claim 8 —" so that Claim 9 no longer depends on itself.

In the amended Claim 22, the phrase "— adjusting the at least one transmission parameter —" was changed to "— adjusting at least one transmission parameter —" in order to provide correct antecedent basis.

4. Section 4 of the Examination Report

The rejection of the claims under 35 U.S.C. 102 is noted.

5. Section 5 of the Examination Report

Claims 1-6 and 8-21 were rejected under 35 U.S.C 102(b) as being anticipated by Xu et. al.

6. Applicant submits that the above-recited step of receiving a plurality of transmission signals with a plurality of receiver elements wherein said plurality of transmission signals are transmitted by a transmitter having a plurality of transmitting elements in the amended independent claim 1 (and hence, in the dependent claims 2-18) clearly presents novel methods that the prior-art references neither describe nor anticipate. Thus, the amended independent claim 1 (and hence, the dependent claims 2-18) should be considered patentable under 35 U.S.C. 102.

7. Applicant submits that the above-recited step of transmitting a plurality of transmission signals from a transmitter having a plurality of transmitting elements wherein the plurality of transmission signals have at least one common frequency channel in the amended independent claim 19 clearly presents a novel method that the prior-art references neither describe nor anticipate. Thus, the amended independent claim 19 should be considered patentable under 35 U.S.C. 102.

8. Applicant submits that the above-recited method of array processing that enables simultaneous frequency use of a plurality of transmitted signals from a transmitter having a plurality of transmitter elements in the amended independent claim 21 clearly presents a novel method that the prior-art references neither describe nor anticipate. Thus, the amended independent claim 21 should be considered patentable under 35 U.S.C. 102.

9. Applicant submits that the above-recited step of providing transmission by a transmitter having a plurality of transmitter elements of a plurality of transmission signals having at least one common frequency channel in the amended independent claim 21 clearly presents a novel method that the prior-art references neither describe nor anticipate. Thus, the amended independent claim 21 should be considered patentable under 35 U.S.C. 102.

10. Specifically, the claimed invention enables point-to-point communications between antenna arrays. In particular, the claimed invention recites a multi-element receiver in

communication with a multi-element transmitter to utilize a plurality of interfering same-frequency channels for communication. The ability to separate the interfering signals at the receiver enables a multi-element transmitter to be employed, thus providing substantial improvements in bandwidth efficiency.

11. By providing a transmitter having a plurality of transmitter elements and a receiver having a plurality of receiver elements, and providing the receiver with the means to separate received co-channel interference, the present invention enables the unusual ability to increase the information throughput in a point-to-point link via frequency reuse. No other prior-art reference discloses a multi-element receiver adapted to separate co-channel interference transmitted by a multi-element transmitter. No other prior-art reference describes a communication method between two antenna arrays that enables the simultaneous use of multiple same-frequency communication channels.

12. **None of the prior-art references teach to reuse frequency channels for communications between a transmitter having a plurality of transmitter elements and a receiver having a plurality of receiver elements.**

Xu et. al. describes a Space-Division Multiple-Access (SDMA) protocol wherein "the only new requirements of this new protocol are an array of multiple antennas installed at a base station and advanced signal processing software to process the received data" (col. 1, lines 14-17). Thus, in Xu's SDMA protocol, communications are not conducted between two or more sites that employ multiple antennas, such as recited in the claims of the present application. Consequently, Xu's SDMA protocol is incapable of supporting frequency reuse for communications between a particular transmitter and a particular receiver, because only one side of the link is adapted to employ multiple antennas.

It will be appreciated therefore that the schema described by the cited art is not the same as that claimed by the present invention. The present claims are therefore novel.

13. The claimed invention is also non-obvious, making the claims patentable under U.S.C. 103.

14. As detailed above, the cited art describes a different type of communication protocol to that claimed by the present invention. Although different to the present invention, such protocols have use, as is evidenced by the teaching of the prior art. Such use is served by the SDMA protocol, and there is no teaching in the prior art to change the type of communication protocol provided so as to resemble or reflect that of the present invention. As there is no motivation to change, no teaching to change, and no description of how any change may be made to produce the protocol recited in the claimed invention, it is submitted that the presently claimed invention is also non-obvious, making the claims patentable under U.S.C. 103.

15. Section 6 of the Examination Report

Claim 22 was rejected under 35 U.S.C 102(e) as being anticipated by Laasko et. al.

16. Applicant submits that the above-recited step of receiving a plurality of transmission signals transmitted in at least one common frequency channel by said plurality of receiver elements for providing a plurality of received signals in the amended independent claim 22 clearly presents a novel method that the prior-art references neither describe nor anticipate. Thus, the amended independent claim 22 should be considered patentable under 35 U.S.C. 102.

17. Specifically, the claimed invention enables an optimized separation of interfering signals received by multiple antenna elements of a receiver array. In particular, the claimed invention recites a multi-element receiver utilizing a plurality of interfering same-frequency channels for communication. In this case, the ability to separate the interfering signals at the receiver enables substantial improvements in bandwidth efficiency and frequency reuse for all types of communication signals.

18. By providing a receiver having a plurality of receiver elements, and providing the receiver with the means to optimize separation of received interfering signals (via providing at least one determination of signal quality for at least one of a plurality of separated signals, providing at least one feedback signal to at least one transmitter, and adjusting at least one transmission parameter to adjust co-channel interference of at least one received signal), the present invention enables the unusual ability to increase the information throughput at a receiver via frequency reuse. No other prior-art reference discloses this optimization process in a multi-element receiver adapted to separate co-channel interference.

19. **None of the prior-art references teach to optimize separation of received interfering signals (via providing signal-quality determination, providing a feedback signal, and adjusting transmission parameters) for a receiver having a plurality of receiver elements.**

Laasko shows a method and apparatus for compensating for multiple-access interference in a CDMA system. Although each user shares the same frequency channel with other users, user signals are separable via orthogonal coding (col. 1, lines 34-49). Multipath, or other channel distortions, cause multiple-access interference between user codes (col. 1, lines 50-65). Laasko teaches to mitigate this multiple-access interference via interference cancellation. Thus, Laasko teaches no increase in throughput beyond what can be achieved by orthogonal CDMA (col. 3, lines 19-23). Laasko merely teaches to compensate for multipath effects that would otherwise reduce the capacity of a CDMA system. Furthermore, Laasko shows only a **single** receiver element for receiving a plurality of transmitted signals (Figures 1,2, and 5). Similarly, Laasko shows only one receive-signal input (signal r(t) 40 in Figure 4), thus implying only one receiver element. Consequently, Laasko fails to show any method or apparatus that is even capable of providing frequency reuse (i.e., sharing of multiple same-frequency channels by a plurality of signals providing predetermined amounts of co-channel interference).

It will be appreciated therefore that the schema described by the cited art is not the same as that claimed by the present invention. The present claims are therefore novel.

20. The claimed invention is also non-obvious, making the claim 22 patentable under U.S.C. 103.

21. Even if multiple antennas were provided at the base station 10 shown in Figure 1 (Laasko), the common prior-art use of such antennas is for diversity combining, and not for frequency reuse. Thus, the combination of multiple base station antennas applied to the teachings in Laasko do not provide any frequency reuse advantage above that already achieved by the CDMA protocol described in Laasko.

As detailed above, the cited art describes a different type of communication protocol to that claimed by the present invention. Although different to the present invention, such protocols have use, as is evidenced by the teaching of the prior art. Such use is served by the CDMA protocol, and there is no teaching in the prior art to change the type of communication protocol provided so as to resemble or reflect that of the present invention. As there is no motivation to change, no teaching to change, and no description of how any change may be made to produce the protocol recited in the claimed invention, it is submitted that the presently claimed invention is also non-obvious, making the claims patentable under U.S.C. 103.

22. Section 7 of the Examination Report

Claim 23 was rejected under 35 U.S.C 102(e) as being anticipated by Martin.

23. Applicant submits that the above-recited method of separating a plurality of received transmission signals transmitted by at least one transmitter having a plurality of transmitter elements, the received transmission signals having known ratios of co-channel interference in the amended independent claim 23 clearly presents a novel method that the prior-art references neither describe nor anticipate. Thus, the amended independent claim 23 should be considered patentable under 35 U.S.C. 102.

24. Specifically, the claimed invention purposefully uses interfering signals to enhance bandwidth efficiency. By measuring interference ratios of a plurality of received interfering signals, Applicant's invention generates weights that enable superior separation of interfering signals in a weight-and-sum canceller. This enables multiple desired signals to share the same frequency channel, thus allowing substantial frequency reuse. No other prior-art reference uses cancellation weights based on **measured interference ratios** rather than relying solely on an **optimization process**, such as maximizing a signal to noise-plus-interference ratio of a received signal.

25. Also, the claimed invention enables point-to-point communications between antenna arrays. In particular, the claimed invention recites a multi-element receiver in communication with a multi-element transmitter to utilize a plurality of interfering same-frequency channels for communication. The ability to separate the interfering signals at the receiver enables a multi-element transmitter to be employed, thus providing substantial improvements in bandwidth efficiency.

26. By providing a transmitter having a plurality of transmitter elements and a receiver having a plurality of receiver elements, and providing the receiver with the means to separate received co-channel interference, the present invention enables the unusual ability to increase the information throughput in a point-to-point link via frequency reuse. No other prior-art reference discloses a multi-element receiver adapted to separate co-channel interference transmitted by a multi-element transmitter. No other prior-art reference describes a communication method between two antenna arrays that enables the simultaneous use of multiple same-frequency communication channels.

27. **None of the prior-art references teach to reuse frequency channels for communications between a transmitter having a plurality of transmitter elements and a receiver having a plurality of receiver elements. Also, none of the prior-art references teach to measure interference ratios.**

Martin describes an **adaptive** signal processor for an antenna array. Martin describes the operation of an adaptive array as designed to **maximize** the signal to interference-plus-noise ratio (col. 1, lines 37-41, and col. 2, lines 6-15). In particular, Martin's system generates weights based solely on **optimizing** a noise-plus-interference correlation matrix (col. 4, lines 8-61). In a receiver that receives a desired signal and multiple interfering signals, the desired transmitter transmits a reference signal (as opposed to Applicant's invention, in which reference signals are preferably transmitted by all transmitters that generate interfering signals). Error is determined as a difference between the received signal and the transmitted reference. The error is **minimized** by an adaptation of weights applied to each receiver element.

Furthermore, Martin shows a system intended for mobile communications (Figure 1) in which a base station has a plurality of antenna elements whereas the mobile units each have only one antenna. Consequently, Martin's disclosure does not mention **array-to-array** processing.

Prior-art techniques do not determine ratios of interference between received interfering signals. Thus, prior-art techniques (including the system and method described by Martin) require complicated adaptation methods that do not achieve the performance benefits and the simplicity of Applicant's invention. None of the prior-art references recognize that known ratios of interference can be used to substantially reduce or eliminate the complexity associated with adaptive signal processing. None of the prior-art references provide **array-to-array** communications. None of the prior-art references recognize that desired transmitted signals may deliberately be made to interfere in order to enhance system capacity via frequency reuse.

It will be appreciated therefore that the schema described by the cited art is not the same as that claimed by the present invention. The present claims are therefore novel.

28. The Novel Physical Feature of the Claims Provide New and Unexpected Results and Hence Should Be Considered Non-obvious, Making the Claims Patentable Under 35 U.S.C. 103.

29. Applicant submits that the above-recited novel features in the independent claims, and hence in all claims, provide new and unexpected results and therefore should be considered non-obvious, making the claims patentable under 35 U.S.C. 103.

30. Specifically, by providing weights that are based on measured interference ratios rather than based solely on an optimization process (such as maximizing a signal-to-interference ratio described by Martin), a substantially higher degree of interference cancellation is achieved. The cancellation afforded by this method is far superior to the performance of any prior-art adaptive signal-processing device or method. Furthermore, the method and apparatus claimed in the present invention enables a communication system comprised of multiple receivers to be substantially free of electromagnetic interference regardless of the electrical characteristics or physical orientation of the electromagnetic receivers. The claimed invention enables superior cancellation without requiring a predetermined spatial separation between transmitters and regardless of the number of angles of arrival of interfering signals.

31. Applicant's invention purposefully generates interfering signals and thus, enables determination of the ratios of interference. Alternatively, optimization is typically performed when no other technique can adequately determine unknown quantities in a measurement. For example, optimization is performed to suppress unknown (and uncontrollable) signals that interfere with **one** desired signal. Unfortunately, the application of optimization (such as adaptive signal processing) to a system having **multiple** interfering desired signals does not exploit the ability to measure interference ratios or control those ratios. However, Applicant's invention deliberately transmits interfering signals having measured (i.e., known) relationships in order to facilitate separation of the signals. This allows Applicant's invention to increase the capacity of a frequency-limited communication channel. Applicant's

invention exploits the ability to control the interfering signals to determine ratios between the interfering signals from which weights can be derived. These weights are substantially more effective for canceling interference than weights generated by a **blind** processing technique, such as adaptive signal processing.

32. Applicant's invention provides a computationally simple means for **measuring** an absolute maximum or minimum. Applicant's invention is also effective in quickly determining the locality of an absolute maximum and/or minimum in the presence of substantial noise. Alternatively, optimization **estimates** the absolute minimum or absolute maximum of a mathematical relationship via iterative processes. In computational systems having a large number of unknowns (e.g., interfering signals), there are typically large numbers of local maxima and minima, whereas there is only one absolute maximum and one absolute minimum. Adaptive processes often mistake a local maximum (minimum) for an absolute maximum (minimum) and thus, are not as accurate as the claimed methods of Applicant's invention.

33. As detailed above, the cited art describes a different type of communication protocol to that claimed by the present invention. Although different to the present invention, such protocols have use, as is evidenced by the teaching of the prior art. Such use is served by the blind-adaptive spatial-processing protocol described in Martin, and there is no teaching in the prior art to change the type of communication protocol provided so as to resemble or reflect that of the present invention. As there is no motivation to change, no teaching to change, and no description of how any change may be made to produce the protocol recited in the claimed invention, it is submitted that the presently claimed invention is also non-obvious, making the claims patentable under U.S.C. 103.

34. Section 8 of the Examination Report

Claim 25 was rejected under 35 U.S.C 102(e) as being anticipated by Barratt et. al.

35. Applicant submits that the above-recited signal canceller capable of separating one or more transmission signals from a plurality of interfering transmission signals transmitted by at least one transmitter having a plurality of transmitter elements and received by a receiver having a plurality of receiver elements in the amended independent claim 25 clearly presents a novel apparatus that the prior-art references neither describe nor anticipate. Thus, the amended independent claim 25 should be considered patentable under 35 U.S.C. 102.

36. Specifically, the claimed invention enables point-to-point communications between antenna arrays. In particular, the claimed invention recites a canceller coupled to a multi-element receiver in communication with a multi-element transmitter to utilize a plurality of interfering same-frequency channels for communication. The ability to separate the interfering signals at the receiver enables a multi-element transmitter to be employed, thus providing substantial improvements in bandwidth efficiency.

37. By providing a transmitter having a plurality of transmitter elements and a receiver having a plurality of receiver elements, and providing the receiver with a canceller to separate received co-channel interference, the present invention enables the unusual ability to increase the information throughput in a point-to-point link via frequency reuse. No other prior-art reference discloses a multi-element receiver adapted to separate co-channel interference transmitted by a multi-element transmitter. No other prior-art reference describes a communication method between two antenna arrays that enables the simultaneous use of multiple same-frequency communication channels.

38. **None of the prior-art references teach to reuse frequency channels for communications between a transmitter having a plurality of transmitter elements and a receiver having a plurality of receiver elements.**

Barratt et. al. shows a remote terminal (Figure 7) having a single antenna 39. Thus a multi-antenna base station communicates with a plurality of single-antenna receivers.

However, Barratt does not show a canceller adapted to operate in an **array-to-array** communication system, such as recited in Claim 25. None of the prior-art references provide **array-to-array** communications. None of the prior-art references recognize that desired transmitted signals may deliberately be made to interfere in order to enhance system capacity via frequency reuse.

It will be appreciated therefore that the schema described by the cited art is not the same as that claimed by the present invention. The present claims are therefore novel.

39. The Novel Physical Feature of the Claims Provide New and Unexpected Results and Hence Should Be Considered Non-obvious, Making the Claims Patentable Under 35 U.S.C. 103.

40. Applicant submits that the above-recited novel features in the independent claims, and hence in all claims, provide new and unexpected results and therefore should be considered non-obvious, making the claims patentable under 35 U.S.C. 103.

41. The claimed invention enables point-to-point communications between antenna arrays. In particular, the claimed invention recites a multi-element receiver in communication with a multi-element transmitter to utilize a plurality of interfering same-frequency channels for communication. The use of a canceller in such a system is a new innovation that provides the ability to employ interfering signals at the transmitter, thus providing substantial improvements in bandwidth efficiency.

42. By providing a transmitter having a plurality of transmitter elements and a receiver having a plurality of receiver elements, and providing the receiver with the means to separate received co-channel interference, the present invention enables the unusual ability to increase the information throughput in a point-to-point link via frequency reuse. No other prior-art reference discloses a multi-element receiver adapted to separate co-channel interference transmitted by a multi-element transmitter. No other prior-art reference describes a communication method between two antenna arrays

that enables the simultaneous use of multiple same-frequency communication channels.

43. As detailed above, the cited art describes a different type of communication protocol to that claimed by the present invention. Although different to the present invention, such protocols have use, as is evidenced by the teaching of the prior art. Such use is served by the blind-adaptive spatial-processing protocol described in Barratt, and there is no teaching in the prior art to change the type of communication protocol provided so as to resemble or reflect that of the present invention. As there is no motivation to change, no teaching to change, and no description of how any change may be made to produce the protocol recited in the claimed invention, it is submitted that the presently claimed invention is also non-obvious, making the claims patentable under U.S.C. 103.

44. Section 9 of the Examination Report

Claims 26-28 were rejected under 35 U.S.C 102(b) as being anticipated by Roy et. al.

45. Applicant submits that the above-recited signal canceller capable of separating one or more transmission signals from a plurality of interfering transmission signals transmitted by at least one transmitter having a plurality of transmitter elements and received by a receiver having a plurality of receiver elements in the amended independent claim 26 clearly presents a novel apparatus that the prior-art references neither describe nor anticipate. Thus, the amended independent claim 26 should be considered patentable under 35 U.S.C. 102.

46. Applicant submits that the above-recited receiver capable of separating one or more transmission signals from a plurality of interfering transmission signals transmitted by at least one transmitter having a plurality of transmitter elements and received by a receiver having a plurality of receiver elements in the amended independent claim 27 (and hence, dependent claim 28) clearly presents a novel apparatus that the prior-art references neither describe nor anticipate. Thus, the amended independent claim 27

(and hence, dependent claim 28) should be considered patentable under 35 U.S.C. 102.

47. Specifically, the claimed invention enables point-to-point communications between antenna arrays. In particular, the claimed invention recites a canceller coupled to a multi-element receiver in communication with a multi-element transmitter to utilize a plurality of interfering same-frequency channels for communication. The ability to separate the interfering signals at the receiver enables a multi-element transmitter to be employed, thus providing substantial improvements in bandwidth efficiency.

48. By providing a transmitter having a plurality of transmitter elements and a receiver having a plurality of receiver elements, and providing the receiver with a canceller to separate received co-channel interference, the present invention enables the unusual ability to increase the information throughput in a point-to-point link via frequency reuse. No other prior-art reference discloses a multi-element receiver adapted to separate co-channel interference transmitted by a multi-elemet transmitter. No other prior-art reference describes a communication method between two antenna arrays that enables the simultaneous use of multiple same-frequency communication channels.

49. **None of the prior-art references teach to reuse frequency channels for communications between a transmitter having a plurality of transmitter elements and a receiver having a plurality of receiver elements.**

Roy describes a method and apparatus for wireless communication between a plurality of remote users and a base station. Each of the remote users is shown having a single antenna (Figure 4, mobile users 20, 22, and 24). Specifically, beam forming is employed at a base-station array (such as illustrated in Figure 6) to position nulls (beam minima) at undesired mobile receivers that are spatially separated from a desired mobile receiver. However, Roy does not show a canceller adapted to operate in an **array-to-array** communication system, such as recited in Claims 26-28. The

methods and apparatus disclosed in Roy cannot be effectively used in array-to-array communications, because the spatial separation between the transmitter array elements is typically insufficient to provide spatial division multiple access, as disclosed by Roy.

None of the prior-art references provide **array-to-array** communications. None of the prior-art references recognize that desired transmitted signals can deliberately be made to interfere in order to enhance system capacity via frequency reuse.

It will be appreciated therefore that the schema described by the cited art is not the same as that claimed by the present invention. The present claims are therefore novel.

50. The Novel Physical Feature of the Claims Provide New and Unexpected Results and Hence Should Be Considered Non-obvious, Making the Claims Patentable Under 35 U.S.C. 103.

51. Applicant submits that the above-recited novel features in the independent claims, and hence in all claims, provide new and unexpected results and therefore should be considered non-obvious, making the claims patentable under 35 U.S.C. 103.

52. The claimed invention enables point-to-point communications between antenna arrays. In particular, the claimed invention recites a multi-element receiver in communication with a multi-element transmitter to utilize a plurality of interfering same-frequency channels for communication. The use of a canceller in such a system is a new innovation that provides the ability to employ interfering signals at the transmitter, thus providing substantial improvements in bandwidth efficiency.

53. By providing a transmitter having a plurality of transmitter elements and a receiver having a plurality of receiver elements, and providing the receiver with the means to separate received co-channel interference, the present invention enables the unusual ability to increase the information throughput in a point-to-point link via frequency

reuse. No other prior-art reference discloses a multi-element receiver adapted to separate co-channel interference transmitted by a multi-element transmitter. No other prior-art reference describes a communication method between two antenna arrays that enables the simultaneous use of multiple same-frequency communication channels.

54. As detailed above, the cited art describes a different type of communication protocol to that claimed by the present invention. Although different to the present invention, such protocols have use, as is evidenced by the teaching of the prior art. Such use is served by the blind-adaptive spatial-processing protocol described in Roy, and there is no teaching in the prior art to change the type of communication protocol provided so as to resemble or reflect that of the present invention. As there is no motivation to change, no teaching to change, and no description of how any change may be made to produce the protocol recited in the claimed invention, it is submitted that the presently claimed invention is also non-obvious, making the claims patentable under U.S.C. 103.

55. Section 10 of the Examination Report

The rejection of Claims 7 and 29 under 35 U.S.C. 103 is noted.

56. Section 11 of the Examination Report

Claim 7 was rejected under 35 U.S.C 103(a) as being unpatentable over Xu et. al. in view of Dogan et. al.

57. Applicant submits that the above-recited method of providing frequency reuse in a communication system wherein the receiver elements include more than two polarization elements and the co-channel interference includes cross polarization, such as in the amended dependent claim 7, clearly presents a novel method that is not obvious in view of combinations of the cited prior-art references. Thus, the amended dependent claim 7 should be considered patentable under 35 U.S.C. 103.

58. The claimed invention teaches against the prior art, making the claimed invention non-obvious.

59. In particular, the dependent claim 7 describes the implementation of more than two cross-polarization channels, which necessitates transmitting interfering signals. Thus, the present invention teaches against the prior art which 1) teaches to use a maximum of two polarizations and 2) teaches to employ orthogonal (i.e., non-interfering) polarizations.

In contrast, Dogan teaches the use of only two polarizations (col. 65, lines 16-52 and Figures 34A and 34B). Dogan does not teach to transmit non-orthogonal polarized signals. Rather Dogan merely teaches how to recover orthogonal polarized transmissions that have been distorted in the propagation channel. Consequently, the combination of Dogan with Xu would not lead one of ordinary skill in the art to employ more than two transmission polarizations nor employ non-orthogonal (i.e., interfering) transmission polarizations, such as recited in Claim 7.

60. The claimed invention provides new and unusual benefits, making the claimed invention non-obvious.

61. The claimed invention enables substantial improvements in frequency reuse (and hence, increases in network throughput) by deliberately interfering transmissions (which the prior art teaches against) and then providing the means to separate the interference.

62. Because the claimed invention incorporates novel methods that are taught against by the prior art, and those methods provide new and unusual results that satisfy the needs of the wireless communications industry, it is submitted that the presently claimed invention is also non-obvious, making the claims patentable under U.S.C. 103.

63. Section 12 of the Examination Report

Claim 29 was rejected under 35 U.S.C 103(a) as being unpatentable over Roy et. al. in view of Dogan et. al.

64. Applicant submits that the above-recited receiver capable of receiving a plurality of algebraically unique proportions of more than two differently polarized transmission signals, such as in the amended independent claim 29, clearly presents novel structure that is not obvious in view of combinations of the cited prior-art references. Thus, the amended independent claim 29 should be considered patentable under 35 U.S.C. 103.

65. The claimed invention teaches against the prior art, making the claimed invention non-obvious.

66. In particular, the independent claim 29 describes an implementation of more than two cross-polarization channels, which necessitates transmitting interfering signals. Thus, the present invention teaches against the prior art which 1) teaches to use a maximum of two polarizations and 2) teaches to employ orthogonal (i.e., non-interfering) polarizations.

In contrast, Dogan teaches the use of only two polarizations (col. 65, lines 16-52 and Figures 34A and 34B). Dogan does not teach to transmit non-orthogonal polarized signals. Rather Dogan merely teaches how to recover orthogonal polarized transmissions that have been distorted in the propagation channel. Consequently, the combination of Dogan with Xu would not lead one of ordinary skill in the art to employ more than two transmission polarizations nor employ non-orthogonal (i.e., interfering) transmission polarizations, such as recited in Claim 29.

67. The claimed invention provides new and unusual benefits, making the claimed invention non-obvious.

68. The claimed invention enables substantial improvements in frequency reuse (and hence, increases in network throughput) by deliberately interfering transmissions

(which the prior art teaches against) and then providing the means to separate the interference.

69. Because the claimed invention incorporates novel methods that are taught against by the prior art, and those methods provide new and unusual results that satisfy the needs of the wireless communications industry, it is submitted that the presently claimed invention is also non-obvious, making the claims patentable under U.S.C. 103.

The Cited but Non-Applied References

70. The prior-art references made of record and not relied upon have been studied, but are submitted to be less relevant than the relied-upon references.

Very respectfully,

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